

MASTER OF SCIENCE IN OPERATIONS RESEARCH

THE COST OF MAINTAINING A NAVAL INVENTORY SYSTEM WITH INACCURATE RECORDS

**Gerald F. Burch-Lieutenant Commander, United States Navy
B.A., University of Texas, 1993**

Master of Science in Operations Research-March 2003

Advisor: Robert A. Koyak, Department of Operations Research

Second Reader: Samuel E. Buttrey, Department of Operations Research

Management of the Naval integrated supply system depends on data to provide reliable information on the quantities of items in stock at any given time. Because of the high volume of transactions that continually alter data in the inventory system, inventory record errors are practically unavoidable. The purpose of this thesis is to determine the effects of inventory data errors on both cost and effectiveness of operations at a Naval inventory site.

The methodology adopted for research consists of a series of multiple-item, single-warehouse, Monte Carlo simulations, focused on one U.S. Navy inventory site, using estimates of inventory data accuracy obtained at that site. Results of the simulations show that inventory costs can be decreased and customer demand effectiveness increased by decreasing the magnitude of inventory record errors to less than ten percent. It is therefore recommended that the Navy expand its inventory accuracy goal to require that no item have an inventory record error magnitude greater than ten percent. Inventory costs and effectiveness in meeting demand for Naval material were not found to be substantially affected by inventory record inaccuracy if the magnitude of error is less than ten percent.

KEYWORDS: Inventory Accuracy, Naval Inventory System, Operations Research, Inventory Simulation

AN ANALYSIS OF THE IMPACT OF DATA ERRORS ON BACKORDER RATES IN THE F404 ENGINE SYSTEM

**Patrick A. R. Burson-Lieutenant Commander, United States Navy
B.A., Northwestern University, 1991**

Master of Science in Operations Research-March 2003

Advisor: Robert A. Koyak, Department of Operations Research

Second Reader: Samuel E. Buttrey, Department of Operations Research

In the management of the U.S. Naval inventory, data quality is of critical importance. Errors in major inventory databases contribute to increased operational costs, reduced revenue, and loss of confidence in the reliability of the supply system. Maintaining error-free databases is not a realistic objective. Data quality efforts must be prioritized to ensure that limited resources are allocated to achieve the maximum benefit.

This thesis proposes a methodology to assist the Naval Inventory Control Point in the prioritization of its data quality efforts. By linking data errors to Naval inventory performance metrics, statistical testing is used to identify errors that have the greatest adverse impact on inventory operations. By focusing remediation efforts on errors identified in this manner, the Navy can devote its limited resources to improvement of data quality.

Two inventory performance metrics are considered: Supply Material Availability (SMA), an established metric in Naval inventory management, and Backorder Persistence Metric (BPM), which is developed in the thesis. Backorder Persistence measures the duration of time that the ratio of backorders to quarterly demand exceeds a threshold value. Both metrics can be used together to target remediation on reducing shortage costs and improving inventory system performance.

OPERATIONS RESEARCH

KEYWORDS: Data Quality, Statistics, Wilcoxon Rank Sum Test, Inventory, Inventory Performance Metrics, Backorders, F404 Engine System

VALIDATION OF THE UNITED STATES MARINE CORPS QUALIFIED CANDIDATE POPULATION MODEL

William D. Hallahan-Major, United States Marine Corps

B.S., United States Naval Academy, 1987

Master of Science in Operations Research-March 2003

Advisor: Samuel E. Buttrey, Department of Operations Research

Second Reader: LtCol Gregory K. Mislick, USAF, Department of Operations Research

This thesis attempts to verify, validate, and then expand, a model of the population of college students that may be qualified and interested in seeking a commission in the United States Marine Corps. The model, developed by the Center for Naval Analysis during 1999, supports allocation of recruiting goals, location of officer recruiter resources and boundaries, and analysis of the officer recruiting market. The model functions by generating institution-level forecasts of the male baccalaureate cohort, by race and attendance status, and above a certain test eligibility threshold. A survey of colleges and officer recruiters was conducted. Data collected from officer recruiters and examination of the model verifies its underlying assumptions and database. The effort to collect data from postsecondary institutions showed that the model cannot be validated, for the postsecondary education system cannot provide precise measurements. Observations obtained through survey, however, are enhanced with imputation, and then compared against the model's output in order to gain some understanding of the model's performance. In most cases, the model appears to provide a reasonable approximation of the qualified candidate population, as its estimates exceed observed/imputed figures by five to 21 percent, on average. In rare cases, the model may overstate some figures by as much as ninety percent. The survey of colleges also finds that the model's method of estimating levels of mental qualification in a student body produces values that closely agree with college reporting. The study then proposes a means to estimate propensity to seek a commission within a given student body, based on the mean time by which geographic entities historically complete half their recruiting goal. Finally, the research develops a spreadsheet application that enables recruiting planners to analyze and forecast population trends through fiscal year 2004. The forecasts rely upon Holt's method of double exponential smoothing.

KEYWORDS: Recruiting, Officer Recruiting, Officer Candidates, Institutional Research, Model Verification, Model Validation, Survey, Youth Attitudinal Tracking Survey (YATS), Propensity, Population Model, Forecasting, Double Exponential Smoothing, Holt's Method

LOGISTICAL ANALYSIS OF THE LITTORAL COMBAT SHIP

David D. Rudko-Lieutenant Commander, United States Naval Reserve

B.S., United States Naval Academy, 1992

Master of Science in Operations Research-March 2003

Advisor: David A. Schrady, Department of Operations Research

Second Reader: CDR Kevin J. Maher, USN, Department of Operations Research

The purpose of the Littoral Combat Ship is to provide the Navy with an affordable, small, multi-mission ship capable of independent, interdependent, and integrated operations inside the littorals. The Littoral Combat Ship will be designed to replace high-value Naval assets when conducting high-end missions such as littoral Anti-Submarine Warfare (ASW), Mine Warfare (MIW) and Anti-Surface Warfare (ASuW), as well as perform low-end missions such as Humanitarian Assistance (HA), Non-combatant Evacuation Operations (NEO) and Maritime Intercept Operations (MIO). In order to accomplish these missions and successfully counter the enemy's littoral denial strategy, the Navy has stated the Littoral Combat Ship must incorporate endurance, speed, payload capacity, sea-keeping, shallow-draft, and mission reconfigurability into a small ship design. However, constraints in current ship design technology make this desired combination of design characteristics in small ships difficult to realize at any cost. This thesis: (1) analyzes the relationship between speed, endurance, and payload to determine the expected displacement of the

OPERATIONS RESEARCH

Littoral Combat Ship, (2) determines the impact of speed, displacement, and significant wave height on Littoral Combat Ship fuel consumption and endurance, and (3) analyzes the implication of findings on Littoral Combat Ship logistics.

KEYWORDS: Littoral Combat Ship, Speed, Range, Payload, Displacement, Significant Wave Height, Fuel Consumption, Endurance, Sea Keeping, Sea State, Crew Effectiveness

